



ODDS AND ENDS

Science and Craft Activities

Aryind Gupta

SCHOLASTIC

ODDS AND ENDS

Arvind Gupta has written a dozen books on science activities, translated over eighty books in Hindi and presented ninety-six films on science activities. His first book *Matchstick Models & Other Science Experiments* has been translated into twelve Indian languages. He has received several honours, including the inaugural national Award for Science Popularisation amongst Children (1988). At present, he is working in Pune, at the Inter-university Centre for Astronomy & Astrophysics Children's Science Centre.

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SCIENCE AND CRAFT ACTIVITIES

Arvind Gupta

**Illustrated by
Monil Dalal**

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Paper Aeroplane

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Make a simple paper aeroplane to understand the various forces acting on it during flight.

You will need

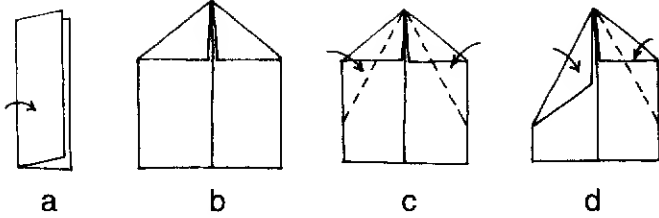
Used sheet of A4 paper (standard paper used in printers and photocopiers), 21.5 x 28 cm

Cellotape

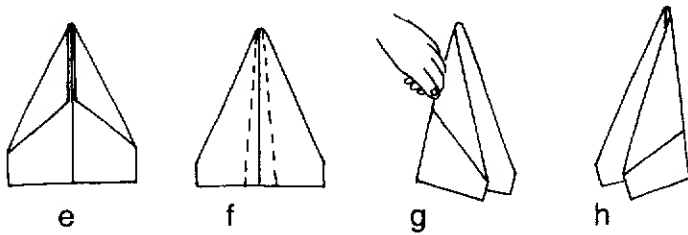
Paper clips

Here we go

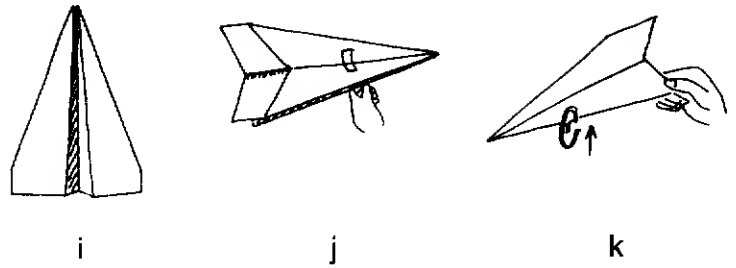
1. Fold the paper in half along the length.
2. Open the paper and fold both corners down towards the centre (refer figures c and d on the following page).
3. Fold one side again towards the centre along the dotted line.



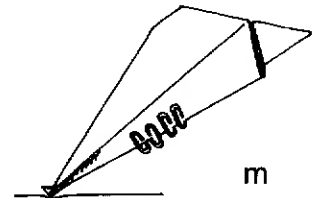
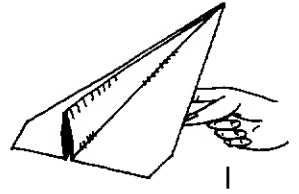
4. Fold the other side along the dotted line. Make sure the folds are sharply creased.
5. Turn the paper over.
6. Fold one side over along the dotted line on the left (f).
7. Fold the other side over along the dotted line on the right (g).



8. The plane should look like the one in figure h, from the bottom.
9. Use a piece of cellotape to hold the body of the plane together. Give its wings a slight upward tilt.
10. Launch the plane. You can increase its thrust by throwing it harder. If the plane flutters and slips from side-to-side, you can put in a paper clip.



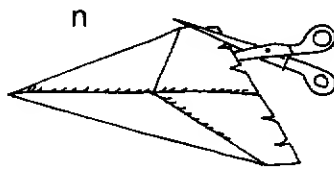
11. The position of the paper clip will change the point at which the plane's weight is balanced. This point is the centre of gravity. To find the centre of gravity of your plane, try to balance it on your fingertip. The point at which the plane balances on your fingertip is its centre of gravity. As the centre of gravity changes according to the position of the paper clips, where should you place the paper clip for the longest flight?



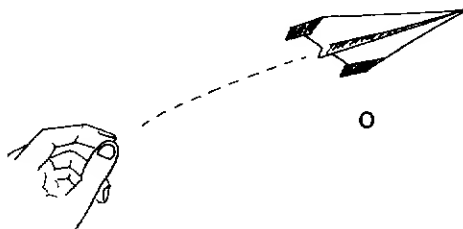
12. Adding a paper clip also adds to the plane's weight. Try putting two paper clips in the same position. Does the plane stay up in the air as long as it does with one clip? Try adding three paper clips. What happens now? What would happen if you put eight paper clips? Real

aeroplanes are made of lightweight metals. Planes must also have their cargo carefully balanced before take-off.

13. Throw your plane against the wind and then try throwing it with the wind. Compare the two flights. In which direction does the wind seem to give the plane more lift? Which way does the flight last longer? Why do pilots try to take off and land aeroplanes into the wind?



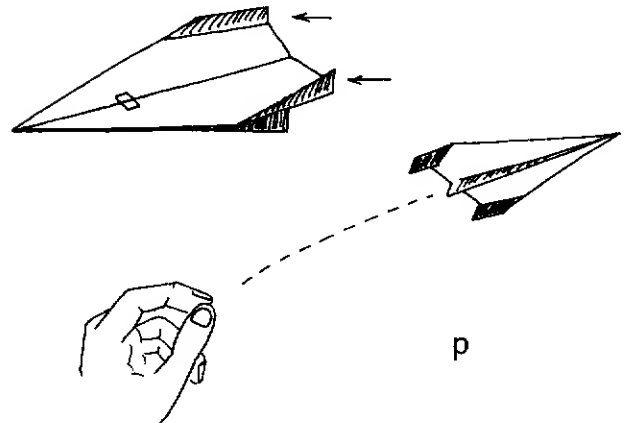
14. Make two 1.3-cm cuts, 3.5 cm apart on the back edge of each wing (see figure n). Fold the paper between the cuts at a slightly upward angle. These flaps will help the plane go up or down. Launch the plane with the flaps at this upward angle. Do the flaps change the flight of the plane? Flatten the flaps and check. Does it make a difference? The flaps change the direction of the flight. As the plane moves through the air, the flaps push against the air. The air pushes back against the flaps with an equal force.



4

15. Make another aeroplane model. This time, fold the edges of the wings upwards about 2.5 cm from the ends. The fold should be parallel to the plane's body and at right angles to the surface of the wings.

The right-angle folds act as vertical stabilisers. A vertical stabiliser makes the plane fly level and helps stop side-to-side swaying. The wings of the plane act as horizontal stabilisers. They help prevent bumpy, up-and-down movement.



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Bird of Peace

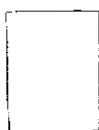
An elegant dove, the bird of peace, can be made from a piece of stiff paper.

You will need

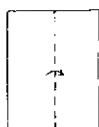
Card paper

Here we go

1. Take a thick 30 x 15 cm sheet of card paper.



2. Fold it in half.



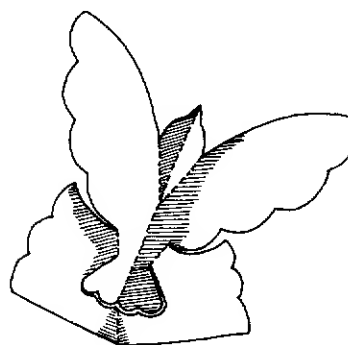
3. Draw a dove on the sheet. Cut along the outline of the sketch. Do not cut the dotted lines.



4. Now fold along the dotted lines.



5. Finally, make the dove stand on its base.



Folding Calendar

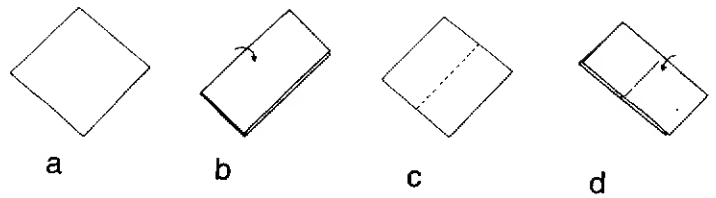
Here is a simple calendar to place on your study-table.

You will need

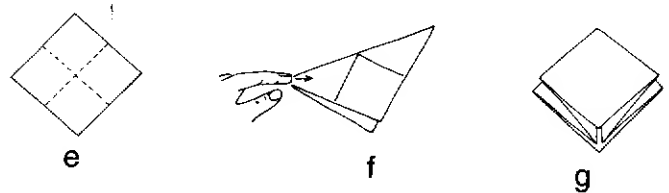
Chart paper
Fevicol

Here we go

1. Take a 25 x 25 cm square piece of paper (refer figures a-d on the following page).
2. Fold in half.
3. Open the fold and re-fold in half in order to make a plus sign.
4. Now fold it along both diagonals and squash to make a small square paper spring. Make three such paper springs.
5. Take two of the springy pieces and glue one on top of the other.

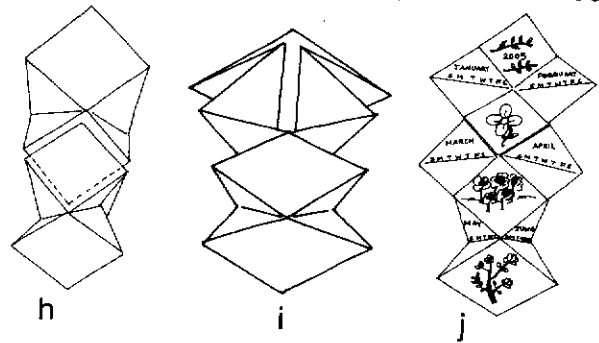


6. Glue the third springy piece to the previous two. Once assembled it should open and close like an accordion.
7. This foldable model can not only be used to make a calendar but also a picture story.



8. Write the dates and the month on the outward folds of the calendar.

This calendar was designed by the Sita School located on the outskirts of Bangalore. Children paint, print and sell these calendars to raise money for their school.



Springy Cat

This is a simple, yet fun toy. When you fan the cat it springs up.

You will need

Empty matchbox

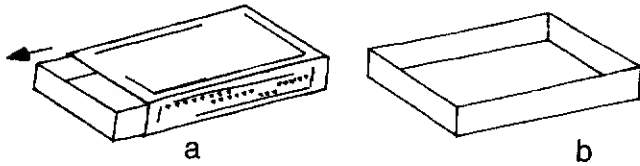
Used A4 paper

Fevicol

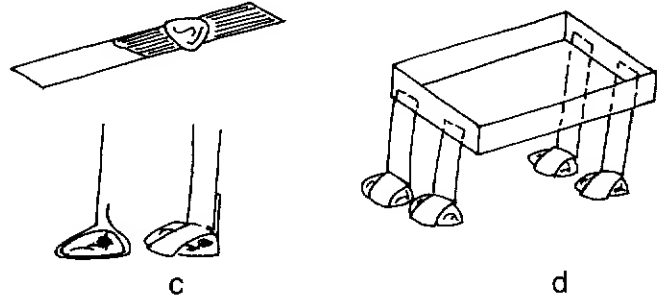
Empty pistachio shells

Here we go

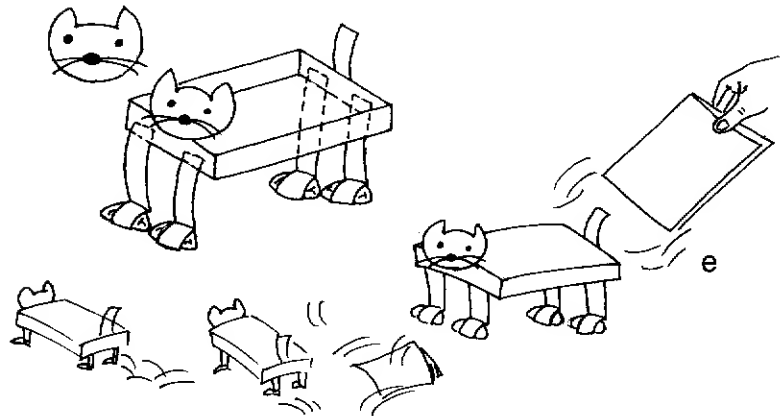
1. Remove the drawer from an empty matchbox to make the cat's body.



2. Take four strips of 5 x 1 cm used paper. Wrap a pistachio shell (or any other light shell) in a thin strip of paper and glue it as shown in figure c.
3. Draw lines with a pen for the paws.



4. Glue the four legs to the matchbox drawer.
5. Fix a face and tail. Draw eyes, a nose and whiskers.
6. Place the cat on the ground and fan it with a notebook. The cat will jump on its springy feet.



Rectangular Paper Box

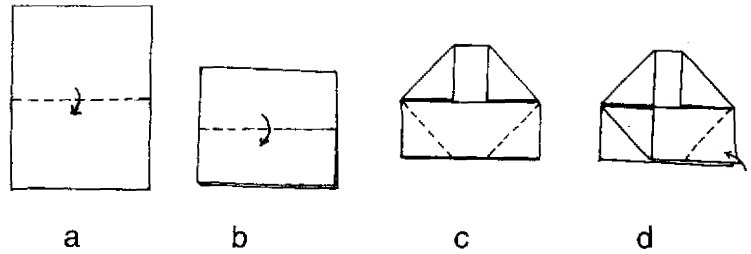
A sheet of paper is all you require to make this useful box.

You will need

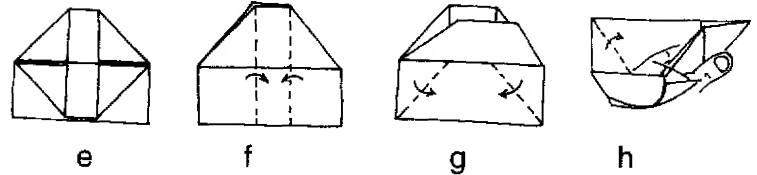
Used sheet of A4 paper

Here we go

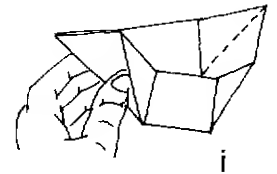
1. Fold the paper in half.
2. Fold it again into quarter.
3. Unfold the paper to make it half the A4 size. Fold the top left and right corners.
4. Fold the bottom left and right corners. (Refer to figures c and d on the following page.)
5. Lift the upper part of the folded paper and place it on top.
6. Fold along the two vertical dotted lines as shown in figure f.



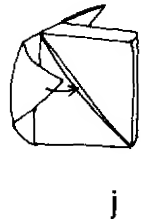
7. Insert your thumbs in the folded paper model and lift it with the help of your index fingers.



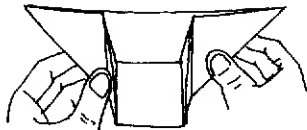
8. Form a triangular flap on the left side.



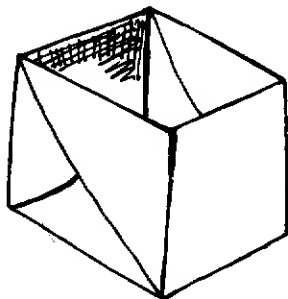
9. Similarly, form a triangular flap on the right side.



10. Tuck both the left and right flaps into the triangular pockets to form a handy rectangular box.



k



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Paper Structures

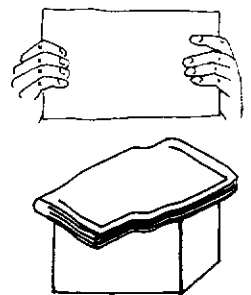
You can learn about engineering and the strength of structures through these simple experiments.

You will need

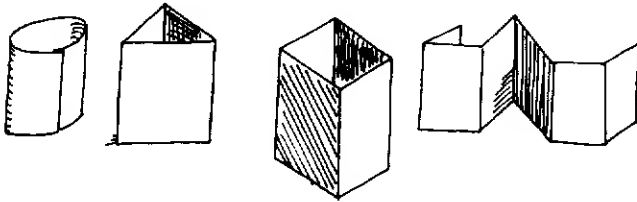
Card paper
Books of various sizes
Plastic glasses
Coins

Here we go

1. Fold a sheet of paper in a V shape and stand it on its edge on a table.
2. Place a book on top. Will the structure support the weight of the book?

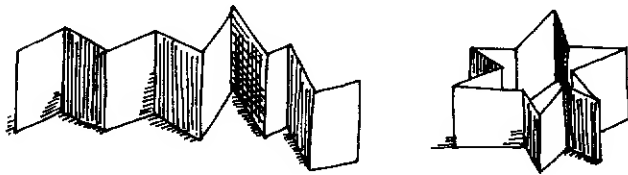


3. Fold sheets of paper in different ways (refer the figures below) to see which of them can support the weight of the book. Will all the structures be equally strong?



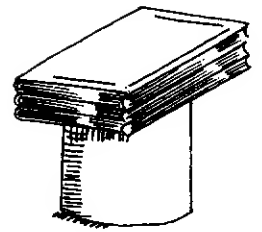
4. One of the ways to test the strength of a structure is to keep loading it until it crumbles or collapses. By trial and error, you will be able to discover that one structure is stronger than all the others and can support more books.

The idea is to keep piling on more and more books until the structure gives way. (Once I folded a 14 x 9 cm postcard into a 9-cm high cylinder. Then I loaded it with books. To my surprise, the postcard

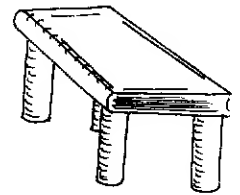


cylinder could support a load of 4 kgs without crumbling!)

5. Roll five sheets of paper into tubes. All the tubes should have a 5-cm diameter and be of the same length. Roll them on a bottle or can to ensure this and then slip them off. Glue or fasten the edges with tape so the tubes keep their shape.



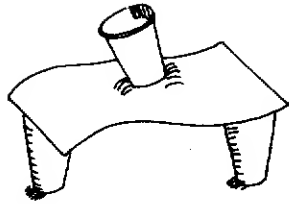
Stand one tube on the floor. Place a book on top. Balance the book carefully, and if necessary steady it with your hand. Place another book on top of this. Continue placing books until your tower gives way and collapses. Note the number of books one tube can support before it collapses. Now place the remaining four tubes on the floor like the legs of a table. Place one book on top like a table top. How many books can this table support?



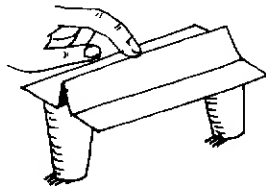
6. L, T, H, I and U are not just simple letters of the alphabet. For engineers, they are the shapes of various beams used in the construction of buildings. Fold I, T, U and L model beams out of paper. Each of these is stronger than a beam

made from a flat sheet. Which of these shapes is the strongest? Test them by loading them appropriately.

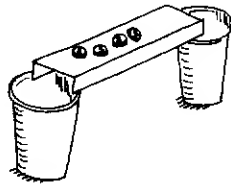
Place two plastic drinking glasses with approximately 15 cm of space between them. Now balance a paper across the top and place a third plastic glass on the bridge in the centre (refer figure). Will the bridge and glasses support the weight of the third plastic glass?



7. Fold or roll papers into different shapes. Place each in turn across the glasses. Press down on the centre of each bridge with your finger, until it collapses. You can guess which shape will withstand the most pressure before it collapses. Which shape turned out to be the strongest?

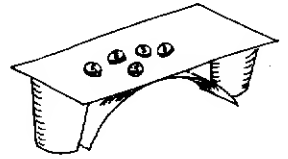


8. A beam is a structure that can stand on its own. Beams are required for making bridges. Cut a 25 x 10 cm sheet of paper. Fold 2.5-cm strips on both

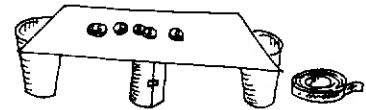


sides to make a long tunnel. Rest the ends of the bridge on the plastic glasses. Now place five-rupee coins on the centre of the bridge until it collapses. Count the number of coins that made the bridge collapse.

9. Continue the experiment by making an arch bridge. Cut a length of paper such that when it makes an arch it is just the height of the glasses (refer figure). Place a flat strip of paper on top of it. Again lay five-rupee coins on top of this bridge and test it. Does it support more weight than a beam bridge?

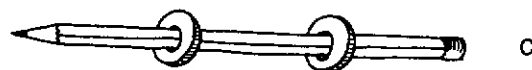
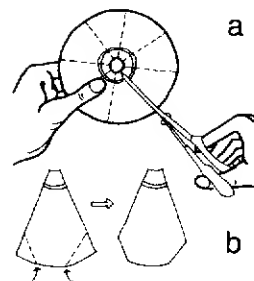


10. The most common bridge is the pier or the pile bridge. Roll a cylinder the exact height of the plastic glasses and place it between the glasses. Place a strip for the road on top. How strong is this bridge once a few coins are placed on it?



It Levitates, it Spins, it Writes!

- Take two ring magnets and fit them on to a pencil. Scrape the pencil if they do not fit easily. The polarities of the magnets does not matter.



This is a simple and inexpensive toy that also demonstrates magnetic levitation.

You will need

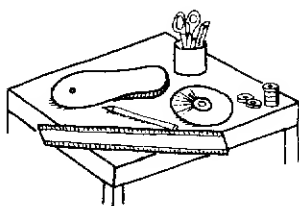
Old CD

Old rubber slipper

Pencil

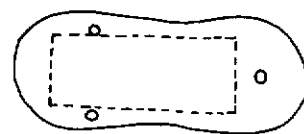
Scissors/Knife

Six ring magnets (17.5 mm outer diameter; 7.5 mm inner diameter; 3 mm thickness)



- Cut a 15 x 7.5 cm rectangle from an old rubber slipper with the help of a sharp knife (see figure d). You might want to take the help of an adult while doing this.

- Draw lines at 2 cm, 6.5 cm and 12.5 cm distance from one end. Now make 5-cm wide cuts on these lines.

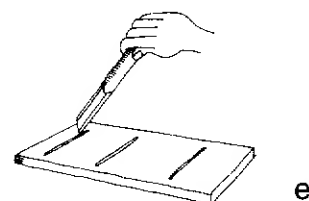


d

Here we go

- Mark out eight equal sectors on the discarded CD. Use a large pair of scissors to cut out one section of the CD.
- Cut the lower corners at an angle (refer figure b on the following page).

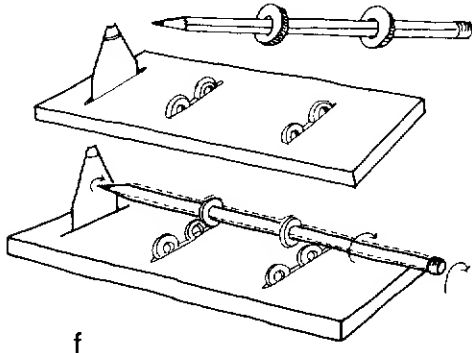
- Insert the CD piece into one slit. Place two ring magnets in the rubber slit next to the CD. These magnets must



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have poles which attract the pencil magnet close to the writing end. Insert two more ring magnets in the remaining slit. These magnets must repel the pencil magnet (away from the writing end).

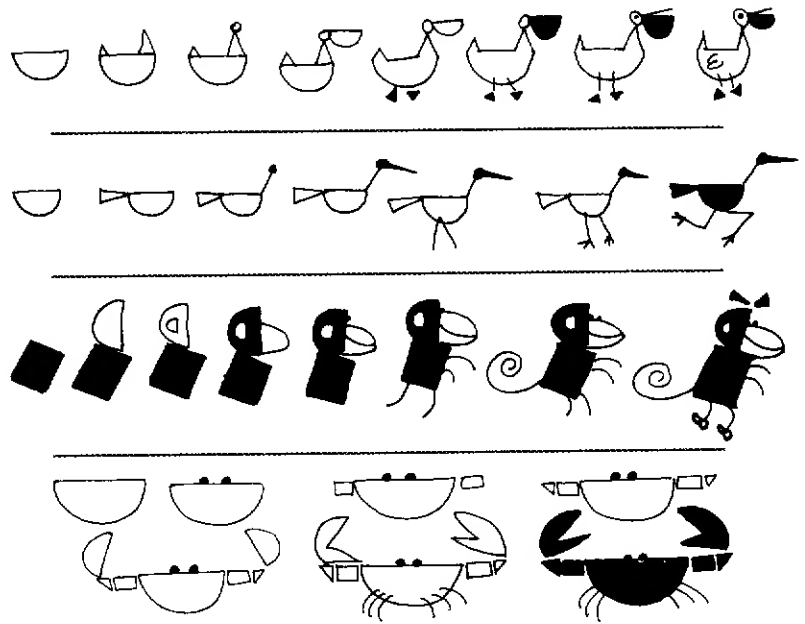
7. If you now place the pencil on the tip of the CD it will levitate in the air. Twirl the rear end of the pencil. The pencil will keep spinning for a long time.

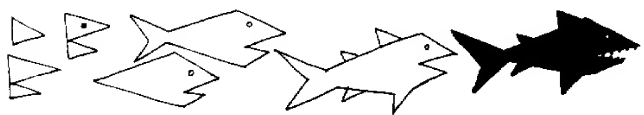
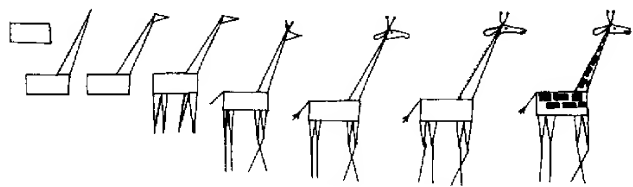
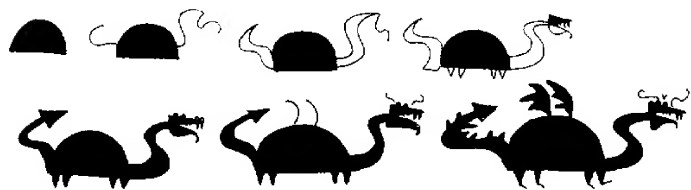
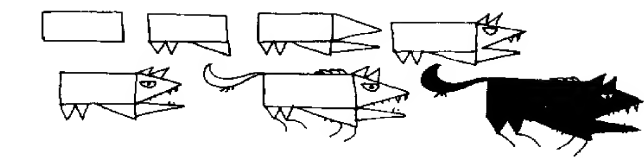


You might have to adjust the positions of the pencil magnets to get the pencil to levitate.

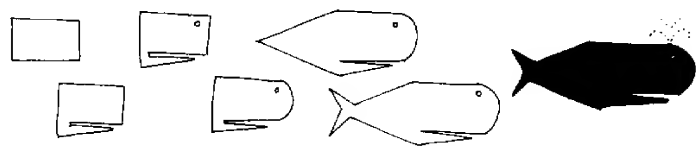
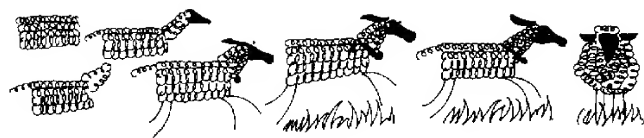
Animal Pictures

If you follow the easy steps below, a difficult picture will be extremely easy to draw.





24



25

Humming Hanger

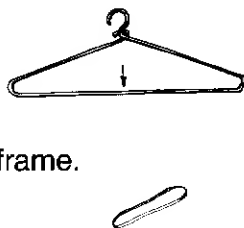
Make a 'roarer' or a 'hummer' out of an ordinary clothes hanger.

You will need

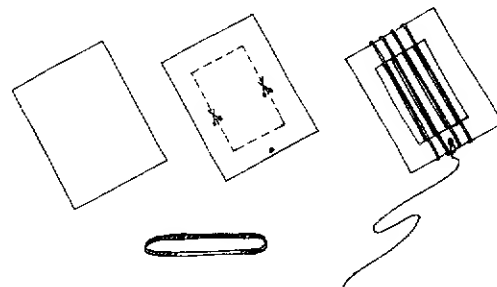
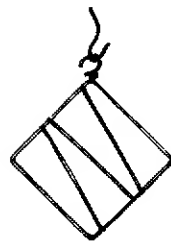
Clothes hanger
Rubber bands
Strong thread
Sheet of stiff cardboard

Here we go

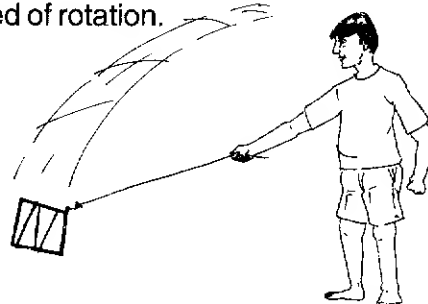
1. Hold the hook of the wire hanger and pull down the middle point of the big side to make a diamond shape.
2. Stretch a few rubber bands and slide them on to the wire frame.



3. Tie a strong thread to the hook of the hanger. Hold one end of the frame and swing the hanger to make a humming noise.
4. Instead of a wire hanger, you could use a cardboard frame. Cut the middle of the cardboard (as shown in the figure) and stretch rubber bands on this frame. Now tie a piece of thread to one end and swing the piece of cardboard. You will hear a humming sound similar to the one made by the hanger.



5. What determines the 'hum'?
 - The stretch of the rubber bands.
 - The pattern of the rubber bands on the frame.
 - The speed of rotation.



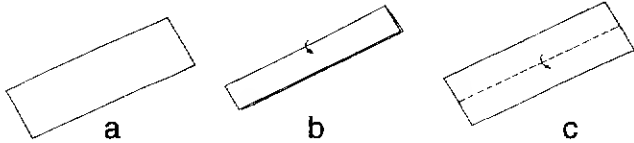
Paper Clapper

This simple-to-make paper clapper is fun to play with.

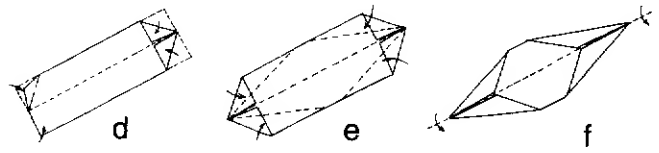
You will need
Used A4 paper

Here we go

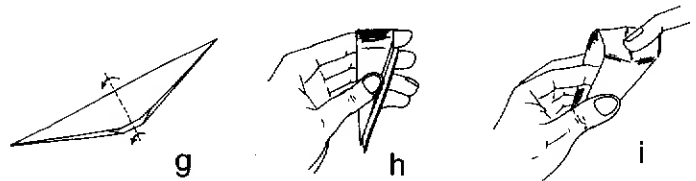
1. Cut the paper in half along the length.
2. Fold it in half.
3. Open the fold.
4. Fold all the four corners as shown in figure d.
5. Once again fold inwards along the four slanting dotted lines as shown in figure e.



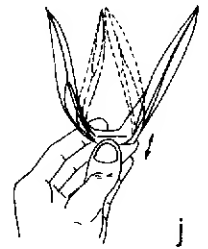
6. Fold the shape in half to get the shape shown in figure f.
7. Now fold along the dotted line in half as shown in figure g.



8. Fold it on your finger so that the fold is a bit rounded.
9. Make a crease at right angles on the rounded fold. This crease will act like a spring.



10. Now hold the clapper with your thumb and index finger as shown. On pressing and releasing your thumb and finger, the clapper hands will clap.



Climbing Man

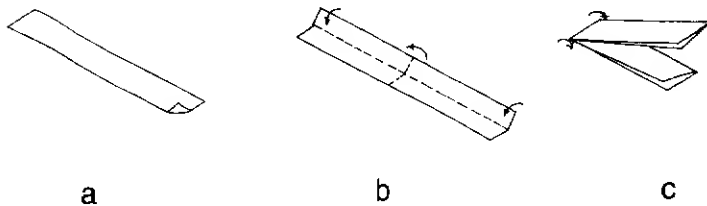
You only need a long strip of brown paper to make this interesting toy.

You will need

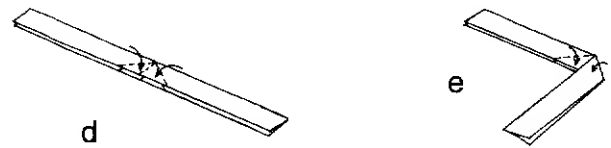
Brown paper sheet (preferably rough)

Here we go

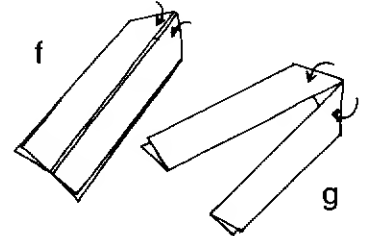
1. Cut a 30 x 8 cm strip of paper.
2. Fold it in half lengthwise.
3. Then fold it to quarter its size as shown in figure c.



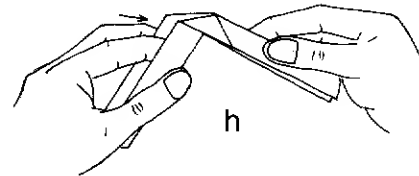
4. Open the strip and fold the corners at a 45 degree angle towards the centre (refer figures d and e).



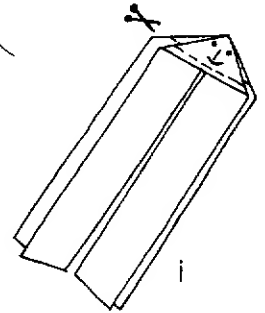
5. Figures f and g show the back view of the folded paper.



6. Now lift the left end at right angles. Squash it in the middle with your index finger. The lifting and squashing of the left end is shown below.

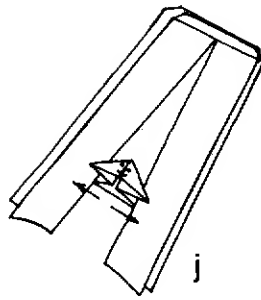


7. You will get two channels with a triangular head. Draw a face on the triangle and cut along the

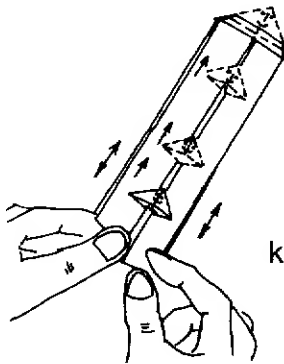


dotted line as shown in figure i on the previous page.

8. Insert the triangular face between the channels.



9. When you alternately push and pull the two ends of the channel, the triangular face will climb up and emerge from the top.



Simple Rain Gauge

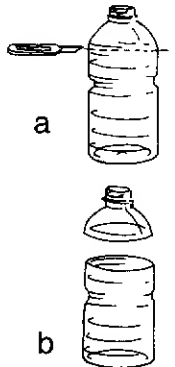
Use a disposable water bottle to make a very simple rain gauge.

You will need

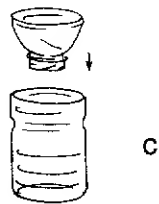
One-litre plastic bottle
Sharp knife
Four bricks (optional)

Here we go

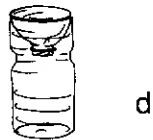
1. Cut the neck of the bottle at the cylindrical portion with a sharp knife.
2. The top end will act like a funnel.



3. Invert the top to make a funnel.



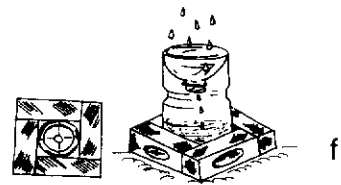
This funnel will prevent evaporation of water.



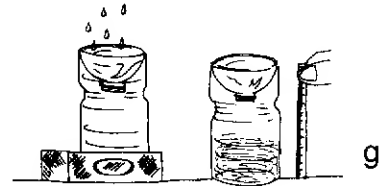
4. To prevent the empty plastic bottle from falling down, dig a hole in the ground and bury the lower end of the bottle in the hole.



You can also place the bottle between four bricks (as shown in figure f on the following page to prevent it from toppling).



5. Periodically measure rainfall with the help of a ruler.



Rubber Stamps

Make lovely collages using these simple rubber stamps.

You will need

Rubber tube from a cycle tyre

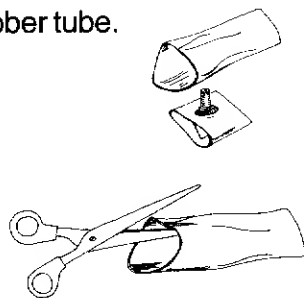
Wooden block

Strong adhesive

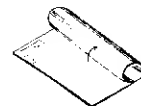
Here we go

1. Take a 10" piece of rubber tube.

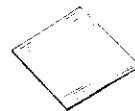
2. Cut it along its length.



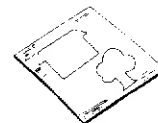
3. Open it up so that it looks like a flat rubber sheet.



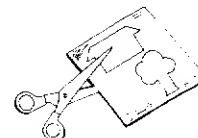
4. Draw a picture of a tree and a house on this rubber sheet.



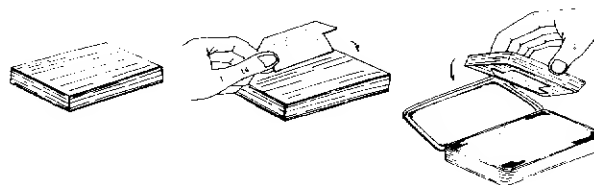
5. Cut out the shape of the house and tree.



6. Stick the house cutout of the rubber sheet on the wooden block with some strong adhesive.

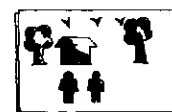
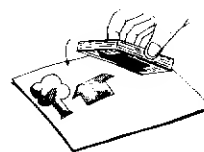


7. Press the rubber stamp on to the ink pad.



8. Print these shapes on a sheet of paper.

9. You can make lovely pictures using these inexpensive rubber stamps.



Floating Ball

Make this interesting model and watch a ball float in the air.

You will need

Flexi-straw

Film canister (film roll container)

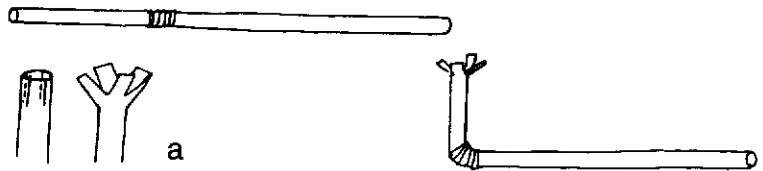
Card paper

Thermocol ball

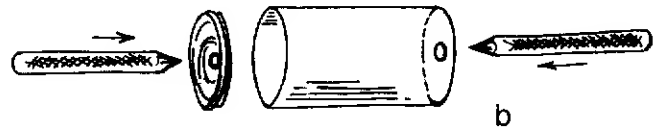
Screwdriver

Here we go

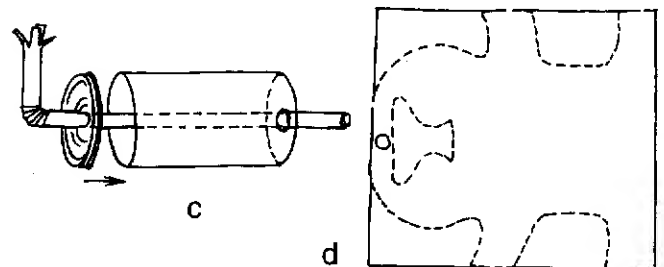
1. Take a plastic straw with accordion pleats (refer figure a on the following page). Such a straw can bend at right angles.
2. Make four symmetrical vertical cuts (1 cm deep) and flare out the pleats.
3. Bend the straw at right angles.



4. Make a hole in the centre of the base and the lid of the film canister. The hole should be just large enough for the plastic straw to fit in it.



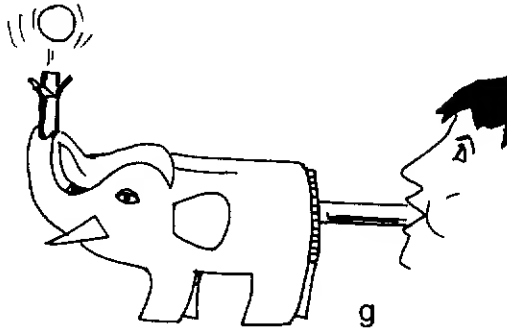
5. Insert the plastic straw into the holes in the film canister.
6. Draw the picture shown in figure d on a thin card sheet. Cut along the dotted lines.



7. Take double pieces of card paper. Cut the ears, tusks and eyes of the elephant and stick them in

place. The body of the elephant should completely enclose the film canister model.

8. Place a thermocol ball in the flared end of the plastic straw and blow from the other end (refer figure below). The ball will lift and float in the air.



Paper Pop-Up

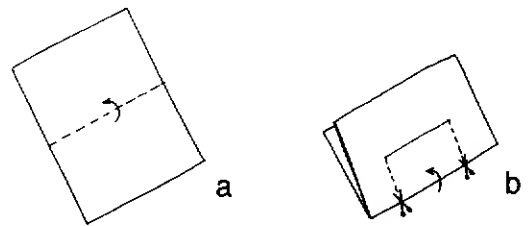
Have fun with this easy-to-make paper pop-up.

You will need

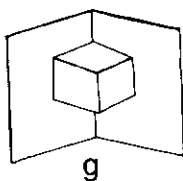
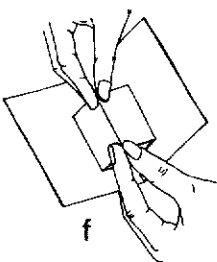
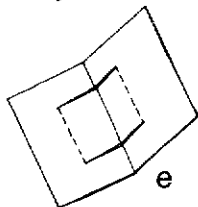
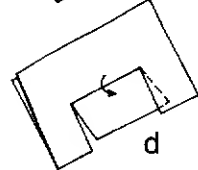
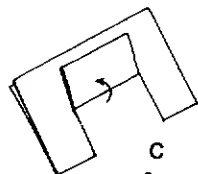
24 x 24 cm card paper

Here we go

1. Fold a sheet of stiff card paper in half.
2. Draw two lines perpendicular to the crease till about halfway up the folded paper and then join them. Cut along the two dotted lines (as shown in figure b).



3. Make a crease between the two slits, and fold the paper upwards.
4. Fold the flap backwards along the same crease-line.
5. Unfold the flap back to its previous position, then open out the card to form a pop-up.
6. Pull up the central portion of the gutter crease to create a mountain. Let all the other creases remain as valleys. Close the pop-up shut and press it flat to strengthen all the creases.



Multi-step Pop-Up

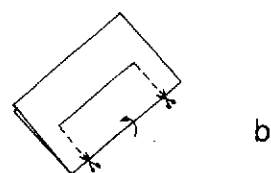
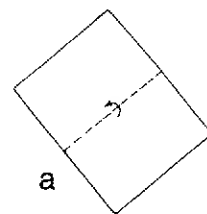
A pop-up, in a pop-up in a pop-up. This three-in-one pop-up makes a unique step ladder.

You will need

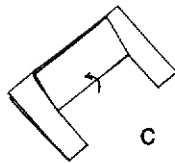
24 x 24 cm card paper

Here we go

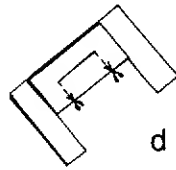
1. Fold a sheet of stiff paper into half.
2. Draw two lines perpendicular to the fold crease till about halfway up the folded paper, and join them. Cut along the dotted lines (as shown in figure b).



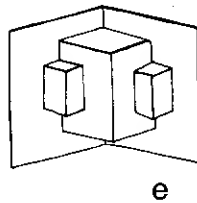
3. Fold a crease between the ends of the slits. Fold the paper, forwards and backwards, along the same line.



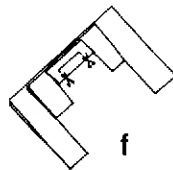
4. Now close the pop-up and make two more slits. Fold a crease between the ends of the slits.



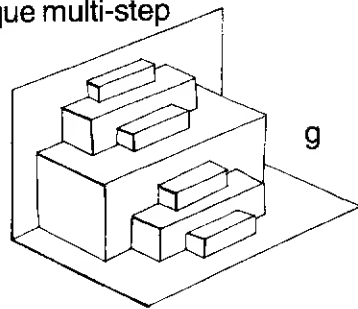
5. At this stage the pop-up will look like the one in figure e.



6. Again, close the pop-up and make two more slits (see figure f). Fold a crease between the ends of the slits.



7. If you open the model carefully, you will get a unique multi-step ladder.



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Balancing Nails

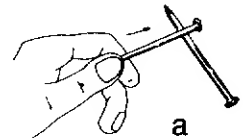
Can you balance a dozen nails on the head of one nail? Sounds impossible! But it can be done very easily.

You will need

Twelve 10-cm long nails
One 12-cm long nail
Small wooden block

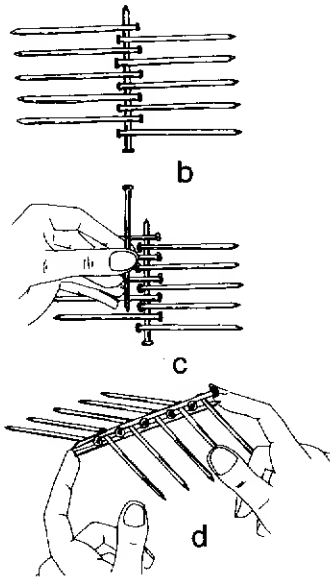
Here we go

1. Place five nails with heads to the right and the other five with their heads to the left on one base nail as shown in figure b on the following page. The total number of nails thus used will be eleven.
2. Place the last nail exactly in line with the first nail so that it rests between the heads of all the nails.



45

3. Next, grip the ends of the two vertical nails and lift up the entire assembly. You will be surprised to see that the nails jut out like roof poles without falling.
4. Hammer a 12-cm nail on a wooden block (figure e).
5. Gently place the assembly of nails on the head of this nail.
6. The entire assembly of nails will rest neatly on the head of one single nail! The assembly is quite stable and will not collapse even if you rock the nails sideways like a swing.



Rocket Projectile

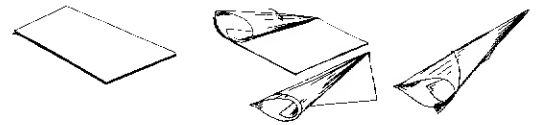
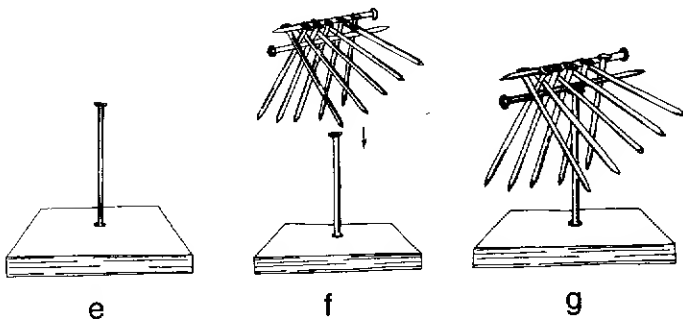
This paper cone 'missile' when blown through a pipe will fly in a trajectory and land at a distance of nearly 15-20 metres!

You will need

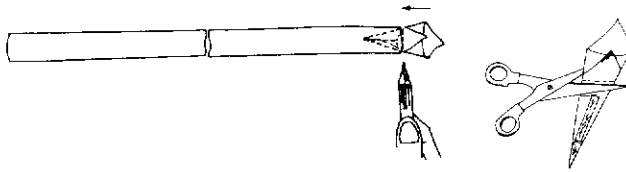
PVC pipe
Used A-4 paper
Tape
Scissors

Here we go

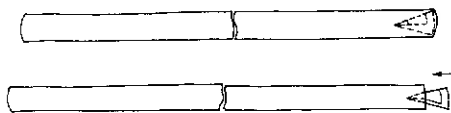
1. Cut the paper to 15 x 25 cm.
2. Fold it into a long conical shape.



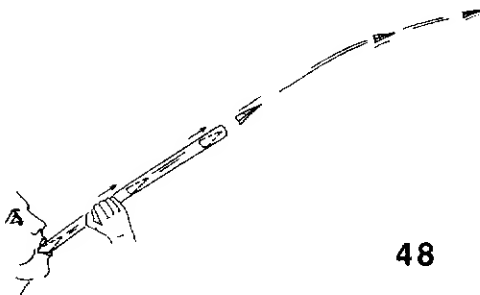
3. Tape the end so that the cone does not open up.
4. Take a 50-cm long PVC pipe with an inside diameter of about 1.2 cm. Push the pointed side of the cone to one end of the pipe.



5. Cut off the jutting out portion of the cone with a pair of scissors.
6. Push the cone until it is flush with the end of the pipe (refer figure).



7. Go to any open space. Hold the pipe at an angle of roughly 45 degrees and blow hard at one end. The cone will shoot like a missile and fall 15-20 metres away.



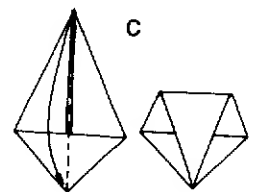
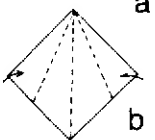
Propelled Boats

These paper boats can dance under the breeze of the fan and fly from one end of the room to the other.

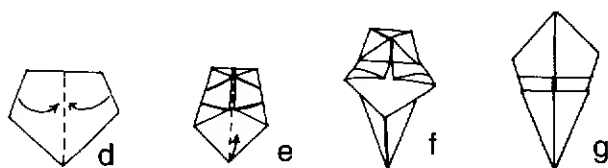
You will need
Paper

Here we go

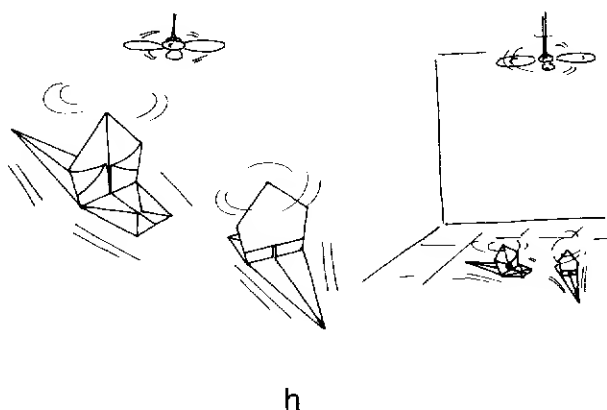
1. Cut a square piece of paper with each side measuring 15 cm.
2. Fold the paper diagonally. Fold the top left and right edges towards the central fold of the diagonal.
3. Now fold the top pointed edge of the paper down till it touches the lowest tip as shown in figure c.



4. Turn the paper over.
5. Fold in the left and right folds towards the middle.
6. Lift the bottom and fold as shown in figure g to make an air-propelled boat.



7. Make several such boats. When kept on the floor under a fan these boats will twirl and float all over the room.



Strange Clay Ball

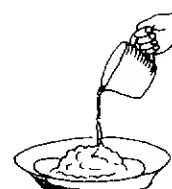
An easy-to-make clay toy.

You will need

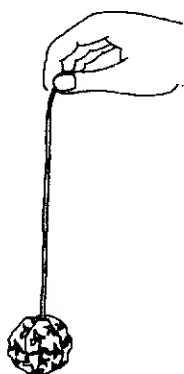
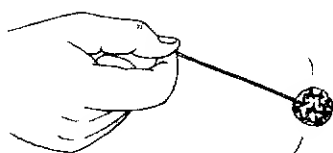
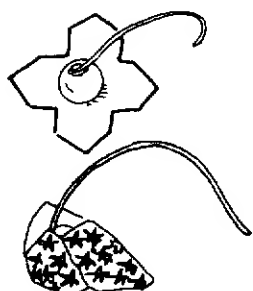
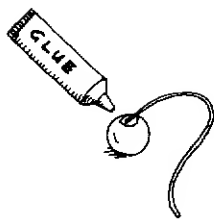
Clay
Strong adhesive/Fevicol
Elastic thread, made of rubber
Thin paper

Here we go

1. Knead clay and make 2-cm diameter clay balls.
2. Dry the clay balls in the sun.
3. Attach a 20-cm-long elastic thread to one ball with the help of Fevicol. Remove the cotton covering from the elastic thread.



4. Take a thin 5 x 5 cm paper and cut it into a flower shape. Apply glue to the paper. Place the ball on the paper and wrap the paper tightly around it.
5. Place the ball on the table and hold the free end of the elastic. Now roll the ball on the paper till the elastic gets twisted.
6. If you hold the free end of the elastic, the ball will rotate and the elastic will make amazing vibrating patterns.



Balloon Pump

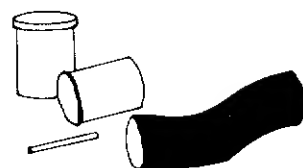
With this simple pump you can inflate a balloon and make it pop!

You will need

Two film roll canisters
15 cm length of old cycle tyre tube
Old ballpoint refill/stiff straw
Cellotape
Divider from geometry set
Scissors

Here we go

1. Make a hole in the base of film roll container A by using a divider. Widen this hole by gently rotating the pointed end



of the scissors. The hole should be about 1 cm in diameter and even.

2. Make a similar hole in cap B.

3. Take 3 cm of sticky tape. (The dots show the 'sticky' side in the figure).

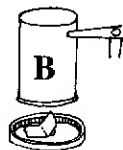
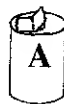
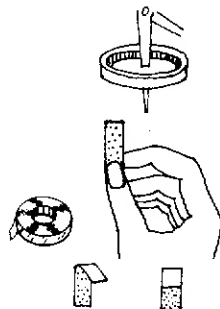
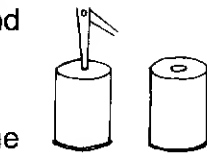
4. Fold 1 cm of the sticky part on itself. The lower 1 cm will still be sticky. Prepare two such tapes.

5. Stick the glue part of one tape to the cap. The tape will act like a hinge. It will open and close like a valve. This will be the **Delivery Valve**.

6. Paste the other tape on the base of the film-reel container A. This will be the **Suction Valve**.

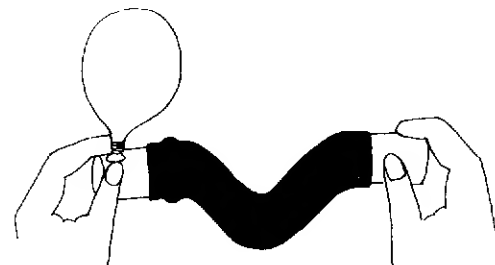
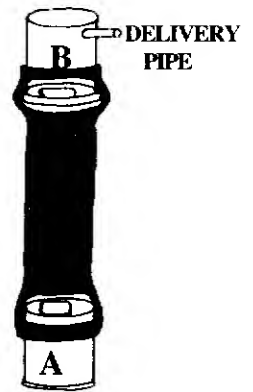
7. Take another film role container (bottle B) and make a small hole on its cylindrical surface. Press-fit a short stiff straw in it for the delivery pipe. Fix cap B with the delivery valve to bottle B.

8. Stretch and slide the piece from the bicycle tube over both the bottles. Bottle B will go lid-down, while bottle A will go bottom-up (refer figure) in



the cycle tube. The bottles will be separated by 7-8 cm of cycle tube. This rubber tube will act like a pair of bellows.

9. Place a medium-sized balloon in the delivery pipe. Fix the balloon to the pipe with a rubber band to prevent any air leak. Now hold the two bottles and quickly bring them closer and then take them apart. This repeated stretching and contracting of the tube like a bellows will inflate the balloon. You can 'pop' a balloon with this simple pump.



Syringe Pump

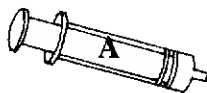
Make a simple force pump using two plastic syringes.

You will need

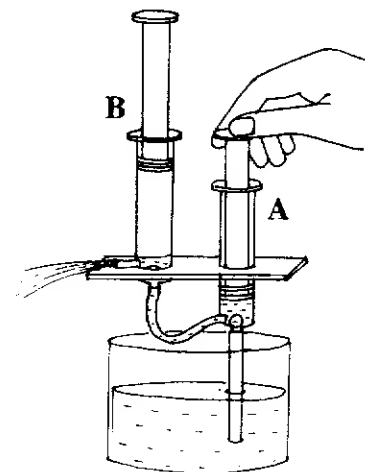
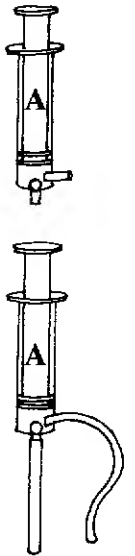
Two 10-ml plastic syringes
Two cycle ball bearings
A stiff plastic straw
A ball point refill
Pieces of saline tube
Small wooden block

Here we go

1. Remove the plunger from syringe A and insert a ball bearing. Put the plunger back. Make a small hole near the nozzle and press-fit a stiff refill (you can also use M-seal or any other strong adhesive to fix it in place).



2. Press-fit a 15-cm-long tube in the nozzle of syringe A.
3. Dip this tube vertically in the water well and suck the water up.
4. Attach a flexible saline tube to the stiff refill.
5. Attach the other end of the flexible saline tube to the nozzle of syringe B. Syringe B should also have a steel ball bearing in its nozzle. Make a hole near the nozzle of syringe B and press-fit a refill for the delivery tube.
6. Mount both the syringes on a small wooden block so as to secure the assembled pieces. Now move the plunger of syringe A up and down. After a while, water will gush out.



Obstacle-race Game

An easy-to-assemble game to be played with marbles.

You will need

Stiff cardboard

Drinking straws

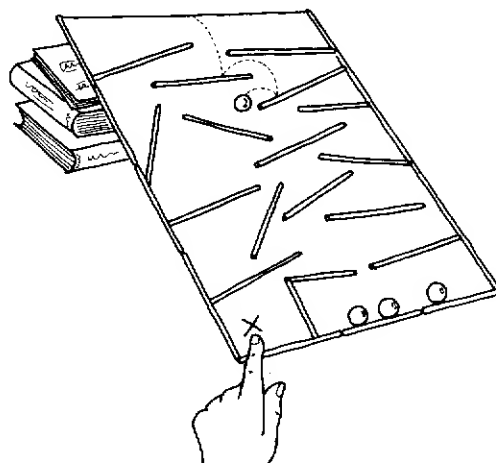
Marbles

Four or five hardbound books

Here we go

1. Cut a sheet of stiff cardboard into a rectangular shape at least 75 cm in length. Glue drinking straws to the bottom of the cardboard and along the two sides (see figure on following page).
2. Glue more drinking straws in a random but somewhat zigzag shape on the cardboard, taking care to leave gaps between the straws.

3. Glue more straws to the bottom right corner of the cardboard to form a box shape, with a space at the top, large enough for a marble to pass through.
4. Draw a small cross on the cardboard about 2.5 cm away from the bottom left-hand corner, and label it the 'tapping spot'.
5. Prop the cardboard against a small pile of books or magazines until it is at an angle. Take care not to make the slope too steep, otherwise the marbles will roll completely over the 'obstacle' straws, rather than be caught by them.
6. You need only five marbles to start playing the obstacle-race game. The object is to roll the marbles from the top of the board into the box-shape at the bottom. Once you have released the marble you must not touch it again. The only way you can manoeuvre it past the obstacle is by tapping the board with one finger on the 'tapping spot'.



Dodecahedron

Make this dodecahedron, the most attractive of the five Platonic solids.

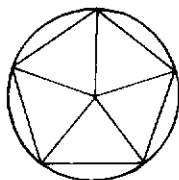
You will need

Stiff card paper

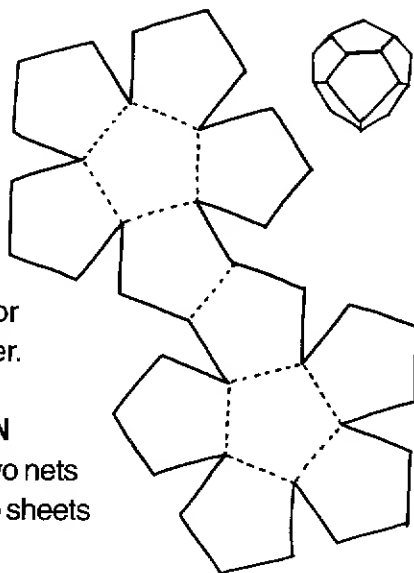
Protractor

Here we go

1. To draw a pentagon, first draw a circle. Then use a protractor to mark off five lines at angles of 72 degrees each, from the centre of the circle. Join the points where the lines touch the sides of the circle.
2. Make a card template of a pentagon and draw round it to make a network of twelve connected

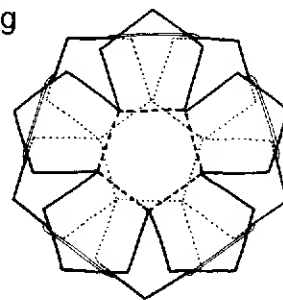


pentagons as shown here. Cut the whole thing out as one piece. Draw the dotted lines as shown in the figure, so that the dodecahedron is easier to fold. Tape or glue the edges together.



A POP-UP DODECAHEDRON

1. Draw and cut out the two nets of six pentagons on two sheets of stiff paper.
2. Fold inwards along the edges of the inner pentagons.
3. Place the two face-to-face so that the bends face inwards and the points overlap. Now weave an elastic band around the points, passing over and under the edges jutting out.
4. When you release it the dodecahedron will spring into shape. The stiffer the card the better. Since it has twelve sides, it also makes a good desk calendar.



Swinging Acrobat

Assemble this simple acrobat and watch him swing.

You will need

Two empty matchboxes

Two wooden battens

Two pieces of 25 cm string

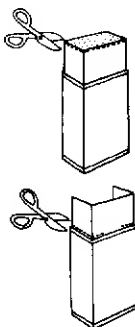
Scissors

Nail Glue Sticky tape

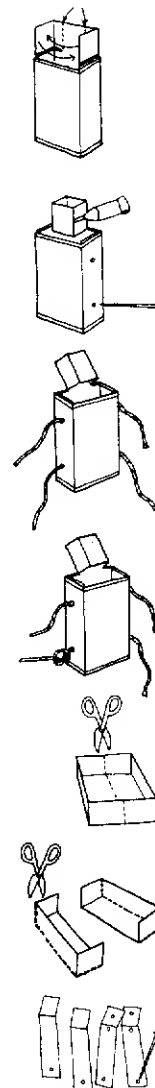
Pencil Ruler Colouring material

Here we go

1. Push out part of one matchbox tray from its casing and cut away the end.
2. Cut into the sides of the tray, above the edge of the casing shown by the dotted line.

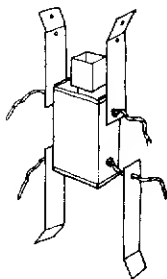


3. Bend the bottom of the tray as shown, so that the side flaps overlap (see figure).
4. Fasten the flaps together with some glue. This forms the acrobat's head.
5. Now make two holes on each side of the box with a nail.
6. Cut two 12-cm long pieces of string. Neatly wrap a small piece of sticky tape around one end of each (to stop the ends from fraying). Thread one string through the top two holes and one through the bottom two holes.
7. Tie a knot on each protruding end, close to the side of the box.
8. Take the tray from the other empty matchbox and cut it in half, along its length.
9. Cut each half as shown to make four similar pieces to form the acrobat's arms and legs.
10. Pierce a hole at one end of each piece as shown in the figure. In two of the pieces, pierce two more holes, 1 cm apart, at the other end.
11. Slip the arms and legs on to the string ends. Tie a knot on each string close

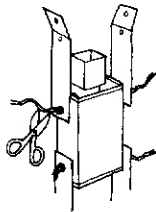


to the arm or leg and cut off the extra portion.

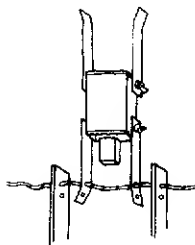
12. Prepare the handles by piercing two holes, 1 cm apart, on each end of the wooden strip.



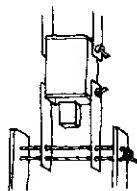
13. Place the acrobat on a table, head down, between the two handles as shown. Take a piece of string, about 25 cm long, and wrap sticky tape around one end. Thread this end through the uppermost holes in the handles and arms.



14. Now take the string back through the lower holes and tie a knot to complete the loop. Cut off any surplus string.

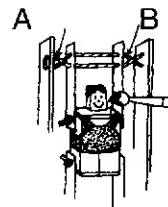


15. Bring down the acrobat so that he lies between the handles. Draw in

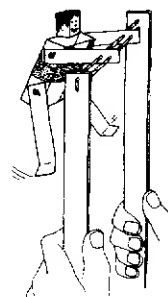


the face and paint on a colourful costume.

16. When you pull the two handles apart the acrobat will swing up and around with his legs flying.



Important: Before using this toy make sure the strings cross at points A and B. The toy will work properly only if the strings are crossed in the right way.



Boxers

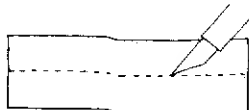
Create these unique card figures and watch them box each other.

You will need

Thick card or soft wood		Thin card
Craft knife	Nail	String
Pencil	Ruler	Sketch pens

Here we go

1. Cut the thick card or soft wood into two 3 x 20 cm strips.



2. Cut two 3 x 15 cm strips of thin card. Draw a simple side view of a man on each, filling up as much of the space as you can, and cut them out.



3. Cut four 1.5 x 6 cm strips of thin card and draw an arm, with a boxing glove on each. Cut them out.



4. Place a cutout arm on each side of one man and use the nail to pierce a hole through both the arms and the body.



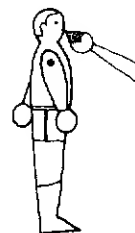
5. Wrap a piece of sticky tape around one end of the string and thread it through the hole in one of the arms.



6. Tie knots in the string close to the arm on either side. Thread the string through the body and tie another knot. Thread through the other arm and tie a final knot.

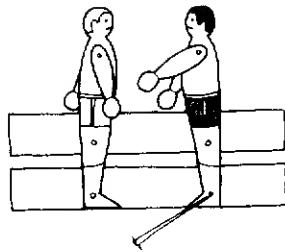


7. Make sure the arms swing freely and then trim off the surplus string. Draw and colour the man to make him look like a boxer. Repeat steps 4 to 7 with the other pieces.

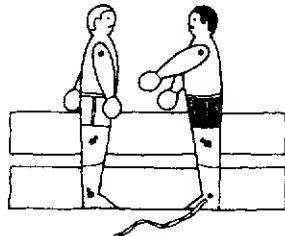


8. Place the two strips of thick card or soft wood on a flat surface 1 cm apart, one above the other. Place the

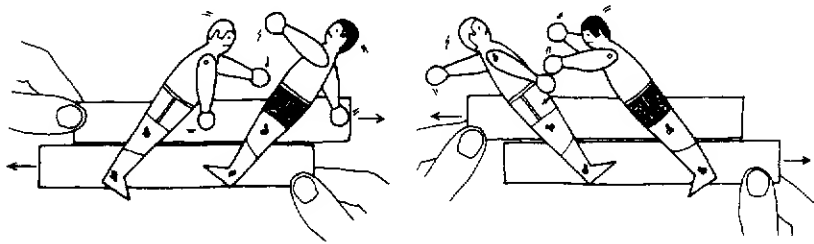
two boxers on these strips, 5 cm from the left and right edges. Make sure they face each other and that their feet rest on the bottom edge. Pierce holes through their ankles and thighs and the supporting strips behind. These should be about 1 cm above the lower edge of each strip.



9. Join the boxers to the supporting strips by threading string through each of the holes and tying knots in front and behind. Trim off the surplus string.



10. Hold the strips at either end, and move them from side to side. The boxers will fight with their arms swinging.



Buzz Saw

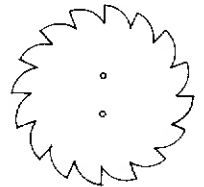
The buzz saw is a model that demonstrates sound.

You will need

Cardboard
Sharp pencil
Piece of string

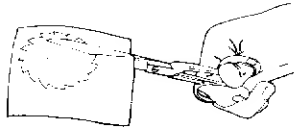
Here we go

1. Draw a circle, approximately 7 cm in diameter, on a piece of cardboard. You can use the bottom of a glass to make the circle. Draw teeth along the circle as shown in the figure.

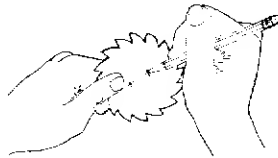


2. Cut the teeth along the edge.

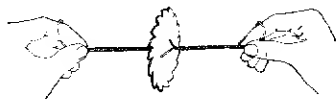
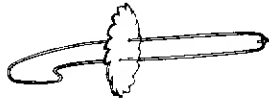
- Now punch two holes roughly 1 cm apart from the centre of the disc. You can make the holes with the tip of a sharp pencil.



- Thread a piece of string through the two holes as shown. Tie the ends together in a knot.



- Wind up the buzz saw by swinging it over and over in the middle of the loops, holding the ends of the strings with your fingers.



- Place a piece of stiff paper on a table so that it juts out from the table edge. Hold the paper in place with a book.
- Spin the buzz saw and bring its teeth into contact with the paper. The tops of the teeth rubbing against the paper will create a shrill noise.

Coconut Craft

Coconut palm leaves can be used to make a variety of birds, insects and animals. These toys are simple, yet beautiful.

Swallow

You will need

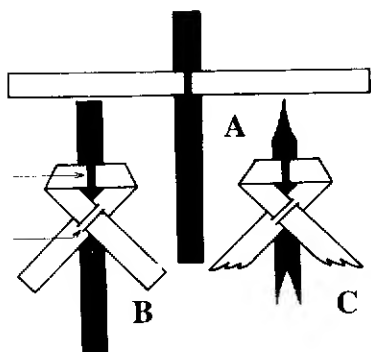
Palm leaves
Scissors

Here we go

- Take two strips of palm leaf (without the midrib) of almost equal width.
- Cut out the wings and tail of a swallow from the strips using a pair of scissors. Overlapping loop strips 'X' and 'Y' can be torn by using your fingers (see figure on the following page). However, the length of the 'loop' should be no longer than the width of the strip that passes through it.

OVERLAPPING
LOOP X

OVERLAPPING
LOOP Y



Windmill

You will need

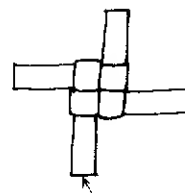
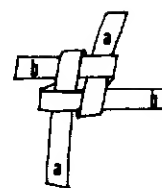
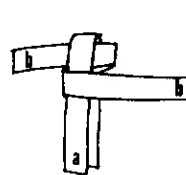
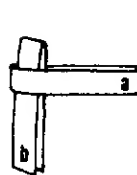
Palm leaves

Bamboo stick or refill

Here we go

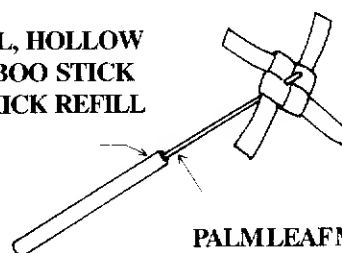
1. Take two strips of palm leaf each about 20 cm long and 2 cm wide.

Follow the steps shown in the figures to complete the windmill.



CUT VANES TO
EQUAL LENGTH

SMALL, HOLLOW
BAMBOO STICK
OR THICK REFILL



PALMLEAF MID-RIB

Jumping Jack

This Jumping Jack is easy to make, and great fun to play with.

You will need

Paper

Cardboard

Scissors

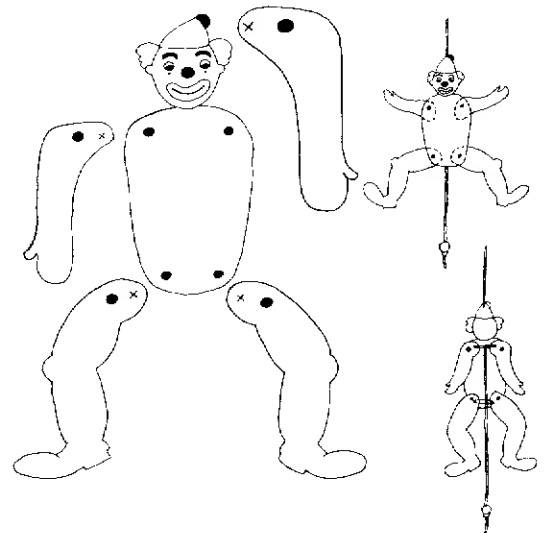
Split paper pin (paper fastener)

Here we go

1. Copy the picture of the clown shown on the following page on a sheet of paper. Cut out the clown and stick it on cardboard. After the glue has dried, cut out the body parts with a pair of scissors.
2. Pierce a hole on the black dots with the help of a nail and at the Xs with a divider point. Attach each arm and leg to the body by inserting a split paper pin or else make a thread hinge by tying knots on

both sides of the figure. The arms and legs should move smoothly around the hinges.

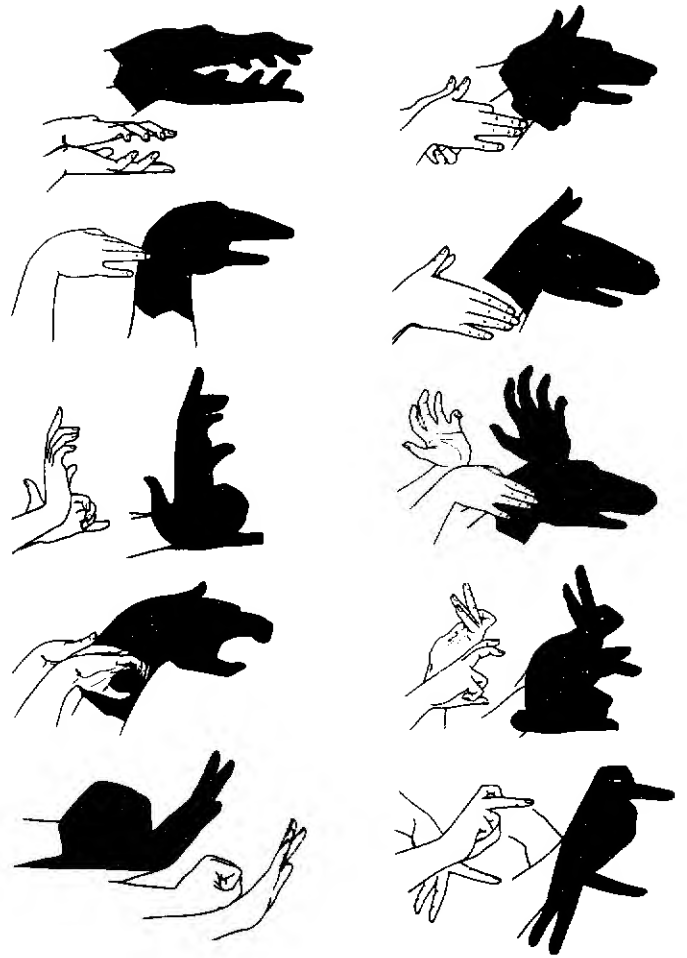
3. Connect the arms by threading a short piece of thin string through the holes at the Xs (see figure). Connect the legs in the same way. The string between the legs and the arms should not sag. Attach a string through the hole at the top of the head. Use another string to tie the arm and leg strings together, allowing about 30 cm of string to hang from the bottom. Decorate the Jumping Jack with sketch pens and colour pencils.
4. To make Jack jump, hang the top loop of thread by a wall nail. Now gently pull the string hanging from the body. The arms and the legs will fly up in the air. On releasing the string the arms and legs will return to their original position.



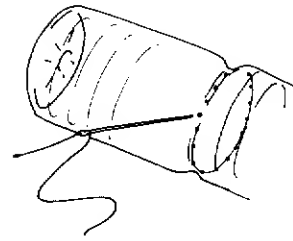
Hand Shadows

Making shadow pictures is great fun. All you need is an electric light without a shade and a sheet. To throw shadow pictures on the sheet you must have your hands between the light and the screen. You will have to adjust your hands and fingers to make interesting pictures on the screen.

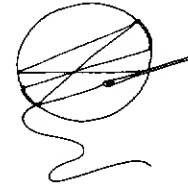
Follow the hand and finger placement shown in the pictures on the next page to make shadow pictures.



Osmosis Bottle



2. With the help of a needle and thread create a 'netting'. This will act like a sieve.



Osmosis causes a raisin soaked in water to swell up like a grape. The skin of the raisin is semi-permeable. It allows molecules of only a certain size to pass through. This simple experiment demonstrates osmosis.

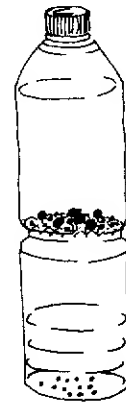
You will need

One 1-litre plastic bottle
Needle
Thread
Beads
Seeds

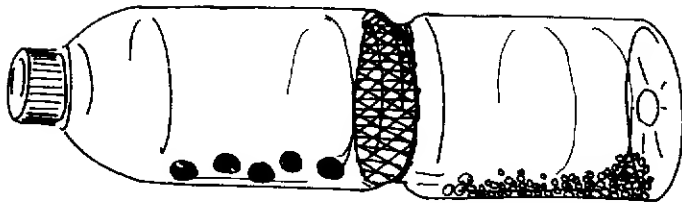
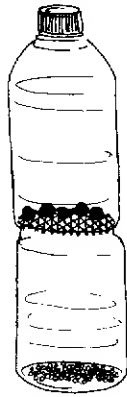
Here we go

1. Take a plastic bottle. Cut the bottle in the middle. Make a series of holes in the middle of the bottle (see figure on following page).

3. Place some big and small beads and seeds in the bottle and close its lid.



4. On shaking the bottle you will find that all the small beads/seeds go down the sieve and only the big ones remain on top.



Spooky Fan

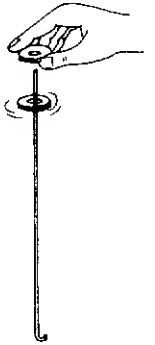
Make this spooky fan to scare your friends with.

You will need

Two ring magnets
Bicycle spoke
Bead
Card paper

Here we go

1. Insert the ring magnets in the spoke. Hold the spoke loosely at the top end. The magnets will go whirling down the spoke and will speed up as they come down. This vibrates the lower end of the spoke.
2. Place a bead (to reduce friction) and a card fan at the lower end of the spoke. The bead enables the

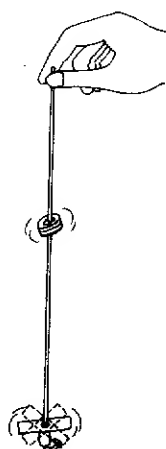


fan to rotate freely. Now place the magnets on the top end and hold the spoke loosely at the top.

3. As the magnets rotate and come down, the spoke vibrates. This makes the card sheet fan rotate. Do the magnets and the fan rotate in the same direction?

For the card sheet fan, simply cut three short strips of card paper and stick them together diagonally. Make a small hole in the centre so the fan can be inserted in the spoke.

This experiment was designed by the sixth class students of Shishu Vihar, located on the Pune University Campus.



Buzzing Insect

Gift your friends this buzzing insect inside an envelope.

You will need

Bicycle spoke

Rubber band

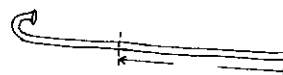
Coat button

Pair of pliers

Envelope

Here we go

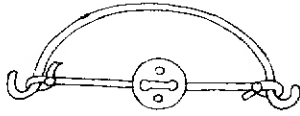
1. Cut 15 cm off a bicycle spoke.



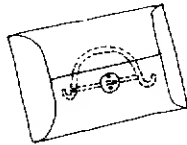
2. Cut a rubber band and weave it into a coat button as shown in the figure.



3. With the help of a pair of pliers, bend the ends of the spoke to make a bow.
4. Tie the two ends of the rubber band to the spoke as shown.
5. Now rotate the button so that you wind up the rubber band.



6. Place the bow inside an envelope, making sure the rubber band does not unwind. Hand over the envelope to a friend. When your friend opens the envelope the button will start spinning against the sides of the envelope, sounding like a buzzing insect!



Flying Kite

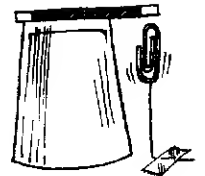
See this magical kite fly in your own room!

You will need

A drinking glass
A bar magnet
Thread
Tape
Paper clip
Card paper

Here we go

1. Turn a glass upside down and place it on a table. Tape a bar magnet on top of the glass. The magnet should extend 3 cm over the edge of the glass.
2. Take 20 cm of thread. Tie one end to a paper clip. Stick the clip to the magnet. Then lightly pull it down



so that there is a gap between the clip and the magnet.

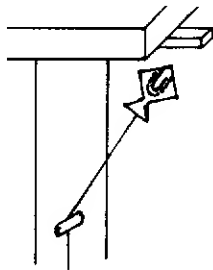
3. Tape the thread to the table so the clip keeps hanging and is still attracted to the magnet.

4. Make a small kite from card paper. Insert a paper clip in the kite.



5. Attach a length of sewing thread to the kite-clip assembly.

6. Now tape a magnet to the edge of the table. Tape the thread such that the kite is attracted to the magnet. If you hide the magnet, then the kite will appear to be flying in the air.



Capillary Cloth

Cloth is made up of several thin fibres. These fibres act as capillaries and draw up water.

You will need

A bowl
Old handkerchief
Old newspaper

Here we go

1. Spread an old newspaper on the floor.
2. Half fill a bowl with water and place it on the newspaper. Put two teaspoons of ink in the water. The ink can be of any colour.
3. Roll an old cloth or handkerchief lightly into a tube shape. Place 5 cm of one end of the cloth tube in the coloured water. Let the rest hang over the side of the bowl on to the newspaper.

4. After 10 minutes, remove the handkerchief and see how much of it is wet. The coloured water will make it easier to see.



Cloth absorbs water through a process called capillary action. The tiny fibres of cloth have small spaces in between them. Water molecules move through the spaces by adhering to the fibres.

As the water molecules move further up the handkerchief, they attract and draw up other water molecules from below, making the entire cloth wet and coloured.

Ice-cream Stick Bomb

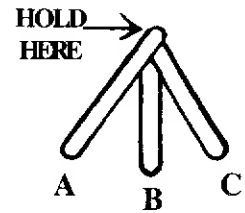
A few ice-cream sticks is all you need for making this gentle bomb.

You will need

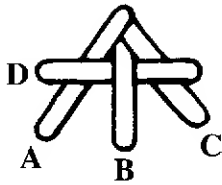
Five ice-cream sticks (used)

Here we go

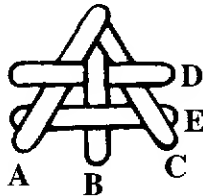
1. Hold three ice-cream sticks A, B and C together at one end with B at the bottom. Spread A and C as shown in the figure.



2. Insert a fourth stick D over A, under B and over C as shown.



3. Insert the last stick E under A, over B, and under C as shown.



4. The assembly of five ice-cream sticks will hold itself together. Try throwing it up in the air or against a wall. When it lands, it will 'explode' and the sticks will fly in all directions.

Acrobat

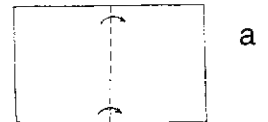
This simple and dynamic acrobat model demonstrates centrifugal force.

You will need

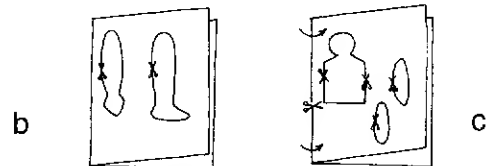
Thick card paper
Broomstick
Needle and thread

Here we go

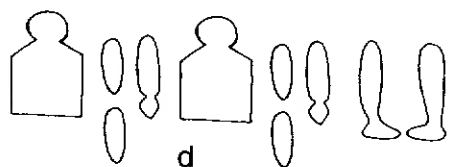
1. Take a thick 30 x 15 cm card sheet. Fold it in half.



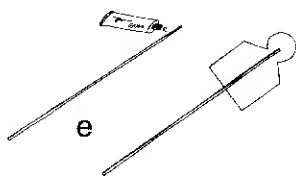
2. Draw a head and body, two forearms, one arm and leg as shown in figures b and c.



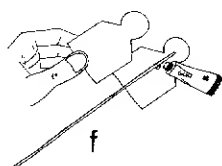
- Cut these out to get ten pieces, as shown in figure d.



- Take a strong 25-cm long broomstick. Apply glue only on the broomstick. Stick it in the middle of one head and body.



- Paste the second head and body on the first as in figure f (apply glue only to the broomstick).

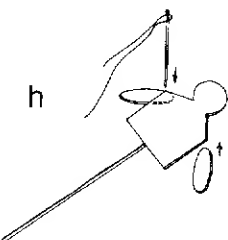


- Thread a long needle with a doubled thread and tie a knot.

- Take two upper arms and place them in between the two layers of the left shoulder and sew as shown in figure h. Do the same for the right shoulder.

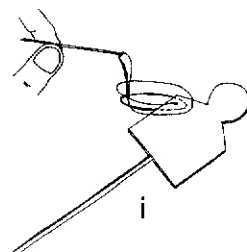


- Pass the needle through. There should be a single knot at one end.

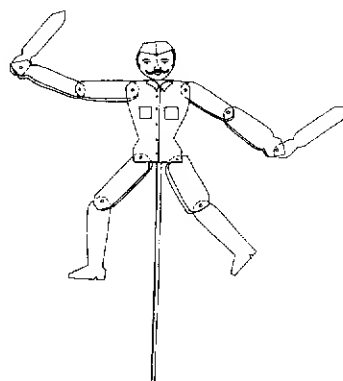
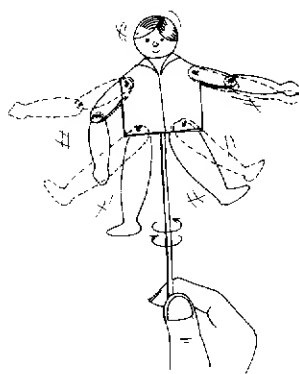
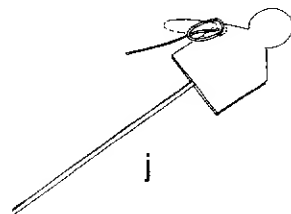


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- Tie a close knot at the other end. The two knots on both ends will make a nice movable hinge.



- Similarly, attach the forearms and legs (one piece each), with thread hinges. The acrobat will now be ready to perform. Hold the broomstick between the thumb and index finger. Twirl the broomstick. The acrobat will wildly swing its arms and legs. You can make creative variations of this dynamic acrobat puppet.



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Glider

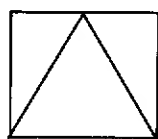
Make this super glider and watch it soar.

You will need

Foam tray
Scissors
Paper clip

Here we go

1. Measure and draw a 10 or 12 cm square on each side on the flat part of a foam tray. Cut out the square. Make a dot on the middle of one edge of this square. Draw lines from the dot to each of the



opposite corners to make a triangle. Cut along the lines to get one big triangle and two small ones.

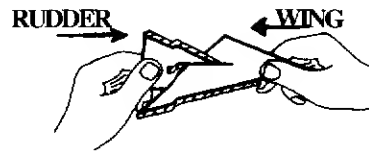
2. The big triangle will be the wing. Measure to the middle of the bottom of the wing and make a dot. Cut a slit from the dot to the centre of the wing and remove the little strip of foam. The slit should be as thick as the foam.



3. One of the small triangles will make the rudder. Cut a slit in it just like the one in the big triangle. Snip off the right corner so that it looks like the one in the figure. (The other triangle could be used as a stepney rudder).



4. Push the rudder into the wing so that the two slits fit together. Tape it to the wing if it feels loose. The rudder will stick out a little from the back of the wing.



5. Now test-fly it. Hold the bottom part of the rudder and throw it forward. If the glider just wobbles and falls on the floor, then it needs more weight in its nose.

